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(54) PCMCIA input/output card connector

(57) An input/output electrical connector (18) is compatible with the PCMCIA Open System Standard. A PCMCIA card assembly uses the connector. This connector (18) is a card I/O connector or header that is mounted on the edge of a PC card. The connector includes a plurality of terminals (60) insert molded in a housing (20). The housing includes a keyed spline (38) and an oppositely facing contact surface (50) with the tops of a row of terminals (60) exposed. The spline is molded by a mold slide that is retracted parallel to the tongue and groove keys and to the terminals (60). Molded ribs (54) are formed in front of the terminals to prevent stubbing during mating. A clam shell shield (80) surrounds the housing and a frame section (100) on the front of the shield defines the peripheral mating interface on the card I/O connector. The shield also includes mounting tabs (82) for securing the shield (80) and the connector (18) to a PC card without the use of separate rivets or fasteners.

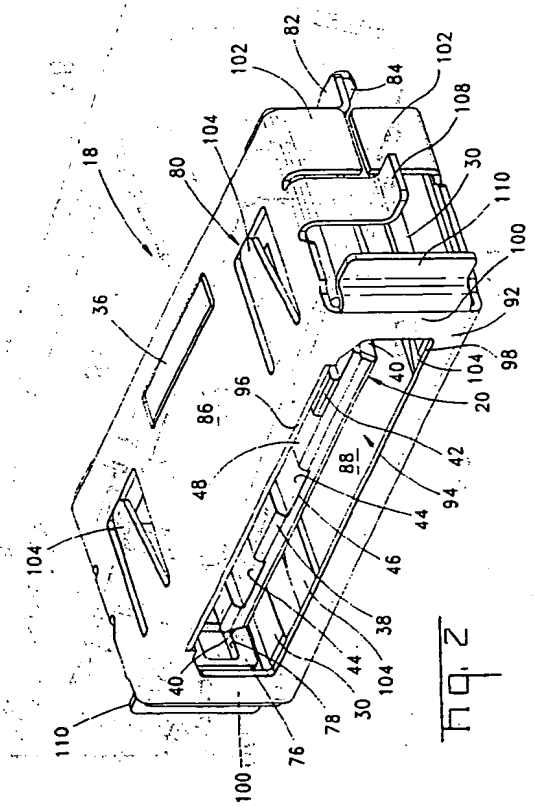

Fig. 2

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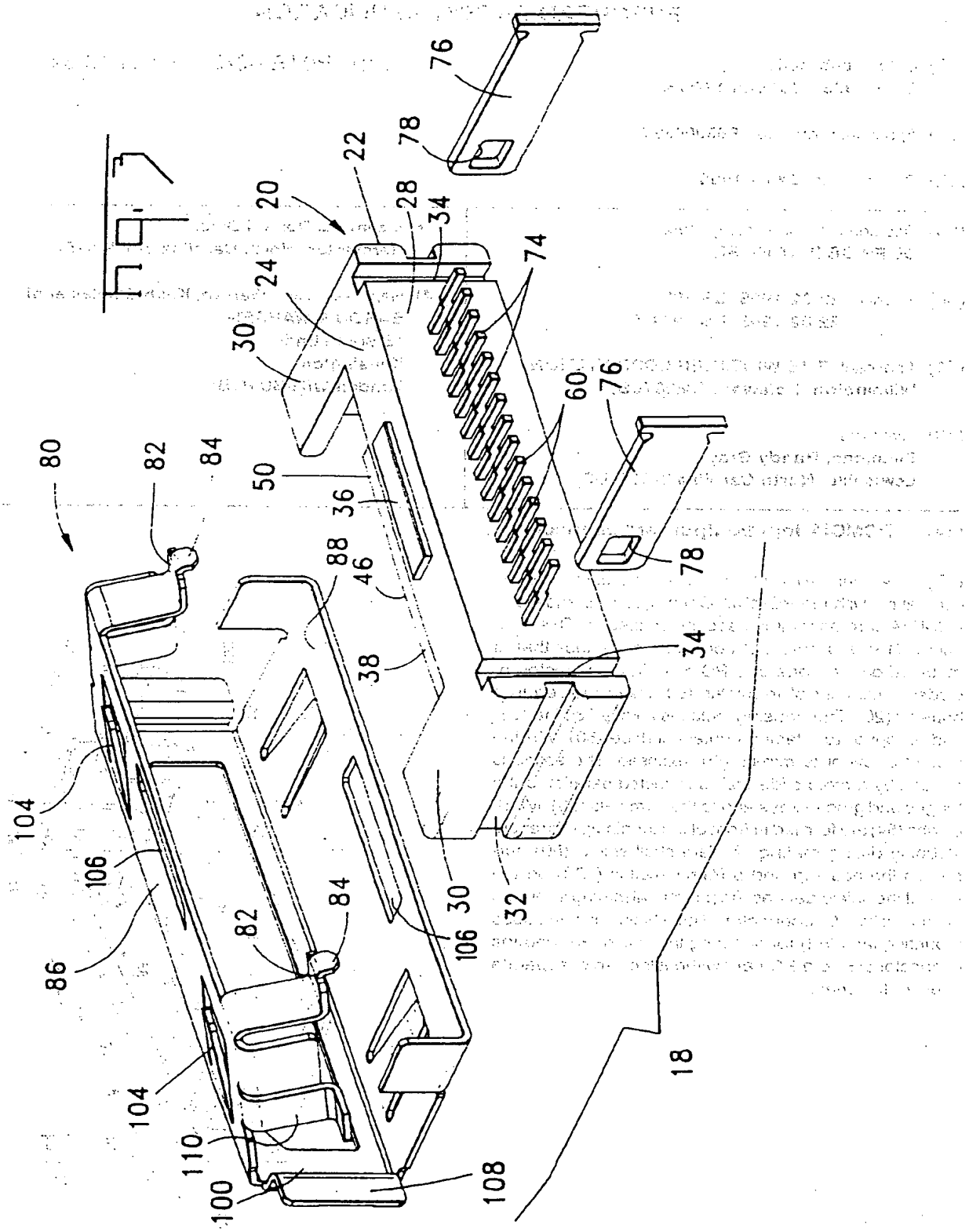
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Description

This invention is related to electrical connectors for providing an interface between a printed circuit card and an external device or component. More specifically, this invention is related to an input/output electrical connector which can be used with a PC Card, such as a PCMCIA card assembly. Still more specifically, this invention is related to an input output electrical connector or header that complies with the PCMCIA Open System Standard for I/O Connectors and can be used as a local area network connector, a modem simple implementation connector, or a modem multifunctional connector.

The Personal Computer Memory Card International Association (PCMCIA) is an organization composed of a number of manufacturers of PC cards and related peripheral equipment. This organization has established standards or specifications for memory cards used with computers and especially for use with laptop, notebook or portable computers. PC cards which meet this PCMCIA standard are credit card-sized wafers. The dimensions of a PCMCIA standard card assembly are 85 mm. in length and 55 mm. wide. These cards employ a high density electrical connector to connect the PC card to the personal computer or other computing equipment with which the PCMCIA card is to be used. This high density electrical connector includes a number of sockets which mate with pins on the computer. This high density connector meets the requirements of PC Card standard, Release 2.0, PCMCIA (September 1991) which defines the PC Card's physical outline and the connector system qualification test parameters, including reliability, durability and environmental test parameters.

PCMCIA cards can be used with laptop or notebook personal computers to provide an interface to a peripheral device such as an external floppy disk drive. PCMCIA cards can also be used as memory cards, including Flash, EPROM, DRAM or as other memory cards. When used in these applications the PCMCIA cards are inserted into a card slot and into engagement with a standard high density connector mounted on a printed circuit board in the computer.

PCMCIA cards are not limited to use as memory cards or external floppy disk drives that have no external connection other than their connection to the computer. These cards can also be used as part of an external modem which is connected to an external telephone line or as part of a local area network interface assembly. Modems and local area networks in turn require specific cable interconnections. For example, a modem will typically require an RJ-11 six position connector for an interface to a standard telephone line. Different local area networks typically require different connections. These local area network interconnections include RJ-45 eight position connectors for shielded or unshielded twisted pair, coaxial connections for Ethernet and fiber optic connections for FDDI local area networks. One approach to implementing these various connections is to use a cable assembly with male and female I/O connectors to the PCMCIA card at one cable end and the specific media connector interface on the other cable end. PCMCIA Card Standard Release 2.0 defines an Open System Standard including a common male and female I/O interface. This Open System Standard includes three distinct mating key configurations. One key is for local area network applications including Ethernet, Token Ring, Arcnet, Fast Ethernet and ATM. A second key configuration is for Modem Simple Implementation. A third key configuration is for Modem Multifunctional. These Open System mating interface key configurations are formed on a keyed housing spline which comprises a generally flat protruding blade on the insulative housing of the Card I/O connector mounted on the PCMCIA card assembly. Different tongue and groove configurations are formed on one surface of this keying spline. Prior art Open System compatible connectors use keys selectively insertable in grooves on the keyed spline to define these different key configurations. Individual keys or tongues are 1.60 mm wide and protrude above the spline surface by 0.250 mm. Grooves are similarly 1.60 mm wide and are recessed into the spline surface by 0.250 mm. Adjacent keys and grooves are located on 4.0 mm centerlines. Side edges of the keyed spline are angled to provide additional keying to distinguish between the three standard configurations.

Pin terminals are located side by side on the opposite surface of the keyed spline. These standard connectors include up to fifteen pins spaced apart on 0.80 mm centerlines. Pins 1 and 15 are make first, break last contacts having a length of 3.9 mm. Pins 2-14 are signal contacts have a length of 3.0 mm. The front ends of the longer make first, break last contacts on the ends of the terminal array are closer to the forward edge of the keyed connector spline than the signal contacts. Therefore, the make first, break last contacts will engage corresponding contacts of the standard cable connector while the signal contacts are disengaged to prevent extraneous signals or excessive signal levels from being transmitted on pins 2-14.

The Open System Standard defining the I/O configuration is intended to promote availability of multisourced I/O connectors satisfying PCMCIA mandated design criteria by promoting uniform implementation interfaces. However, there is no requirement that all I/O connectors meet this standard. Nonstandard I/O connectors will function properly provided that compatible male and female configurations are used. There are a number of prior configurations which predate the Open System Standards. U.S. Patent 5,330,360 discloses a memory card frame kit which uses an I/O connector that does not employ the keying configuration mandated by the PCMCIA Open System Standard. That connector includes an array of pin terminals located on one side of a housing spline, but does not employ tongue and groove keys on the opposite spline surface. That con-

nector also employs an insulative housing with a D-shaped mating interface. A keying rib extends between the D-shaped peripheral mating interface and the centrally positioned spline on commercially available configurations of this connector. Other commercially available versions of I/O connectors include a mating interface in which the outer periphery is defined by a shield with distinct housing keys located on the sides of the mating interface. Versions of these connectors manufactured by AMP Incorporated employ insert molded housings in which the terminals are held in position in a mold by molding pins and the housing is then injection molded around the terminals and the molding pins. The sections of the mold move towards and away from the housing spline and perpendicular to the orientation of the terminals. The molding pins also move away from the housing and small holes, through which the terminals are exposed are left in the conventionally injected molded housing.

I/O connectors that meet the PCMCIA Open System Standard for I/O connectors are also commercially available. Honda Connectors markets and sells a Type I Open System shielded I/O connector in which the shield defines the outer mating interface. The shield on that connector is wrapped around an insulative housing, and a keyed spline extends from the front of the main body of the insulative housing. Grooves are molded on the housing spline and discrete tongues or male keys are inserted into these grooves to form the distinct keyed configurations defined by the Open Systems Standard. The insulative housing includes hold down protrusions. Each protrusion contains a rivet to secure the I/O connector to an edge of the PC card. Individual contacts are inserted through the main body of the insulative housing into position on the lower surface of the housing spline. The forward edges of the make first break last contacts are exposed along the front edge of the spline.

Foxconn Connectors also markets an card I/O connector which meets the PCMCIA Open System Standard. This latter card I/O connector is a thicker Type II connector in which the peripheral mating interface is formed by the insulative housing. A shield is inserted around a portion of the housing. This shield does not extend to the forward edge of the housing, leaving an unshielded gap. This prior art connector also includes contacts that are inserted through holes in the housing base and that are positioned on the lower edge of the housing spline. Individual keys are similarly inserted in molded grooves on the spline lower surface to define different keying configurations. The front ends of the make first, break last contacts are also exposed along the forward edge of the housing spline.

The input/output electrical connector disclosed and claimed herein is specifically intended for use in a PCMCIA card assembly. Although specifically intended for use in a connector which meets the requirement of a Open System Standard, this connector can also be used with other versions of PCMCIA card assemblies and other high density, small PC card applications. This input/output connector includes an insulative housing which is insert molded around terminals. The terminals are positioned along one surface of a housing spline which is formed by a section of the mold which is shifted parallel to the terminals during extraction of the insert molded housing subassembly from the housing mold. The housing spline includes molded ridges extending between the forward edge of the housing spline and the forward end of each terminal to protect the terminals when a cable connector is connected to the edge mounted card I/O connector containing these terminals.

More specifically, the card I/O connector includes a molded insulative housing having a base and a keyed spline extending from the front of the base. An array of terminals are positioned along one surface of the keyed spline. The insulative housing is insert molded around the portion of the terminals extending through the base of the housing. The rear portion of the terminals are configured to mate with a PC Card, and in the preferred embodiment, the rear terminal portions comprise surface mount terminal sections. The keyed spline is molded using a mold slide which is shifted parallel to the portion of the terminals positioned along the lower surface of the spline and parallel to the tongue and groove keys which are formed along the top of the spline. The small terminal contacts can then be held in position by the mold. Small positioning pins need not be included in the mold. These small mold pins are relatively fragile parts of a mold and would tend to reduce its life or increase mold maintenance. By providing lead in sections in the mold, the array of closely spaced small pins can be inserted and properly positioned while reducing the possibility of damaging the pins. The use of a mold slide to form this spline also permits different keyed splines to be molded, by simply using the appropriate mold slide. The top and bottom mold cavities need not be changed. Different keying configurations can therefore be efficiently molded without the need for a secondary operation in which keys are inserted in grooves in distinct patterns.

The keyed spline includes molded ribs in front of each terminal. These ribs protect the terminals during mating so that a mating connector cannot engage the front end of a terminal and bend it back. Since the keyed spline is formed by a mold slide which moves parallel to the terminals, these ribs can be easily molded. These ribs are especially important when used with relatively longer make first, break last pins which are closer to the forward edge of the spline and are therefore otherwise more likely to be damaged.

Perhaps, most significantly, this small connector typically including fifteen terminals, an insulative housing, two striker plates for mechanically engaging a mating cable connector, and a single piece clamshell shield is also readily adaptable to automation to reduce manufacturing cost.

Embodiments of the invention will now be described

by way of example with reference to the accompanying drawings in which:

Figure 1 is an exploded perspective view of the components of a representative PCMCIA card assembly using an input/output electrical connector meeting the requirements of the PCMCIA open systems standard.

Figure 2 is a perspective view of the preferred embodiment of an input/output electrical connector which meets the requirements of the PCMCIA open systems standard.

Figure 3 is an exploded perspective view of the preferred embodiment of this invention showing the main housing subassembly, the shield and the striker plates used in this electrical connector.

Figure 4 is a top plan view of the housing subassembly of the preferred embodiment of this invention showing the keyed housing spline.

Figure 5 is a front view of the mating face of the housing subassembly, shown in Figure 4, showing the keyed housing spline and the position of the terminals on the lower surface of the keyed housing spline.

Figure 6 is a bottom plan view of the housing subassembly shown in Figures 4 and 5 showing the terminals on the bottom surface of the keyed housing spline.

Figure 7 is a side sectional view taken along the section lines 7-7 in Figure 4 which extends through one of the make first, break last terminals located on the ends of the terminal array.

Figure 8 is a side sectional view taken along the section lines 8-8 in Figure 4 which extends through one of the signal terminals located between the make first, break last terminals.

Figure 9 is a perspective view of the housing subassembly showing the terminal mating surface.

Figure 10 is an enlarged view of a portion of the contact surface and the terminals on the housing subassembly shown within the circle 10-10 in Figure 9.

Figure 11 is a perspective view showing the manner in which the housing subassembly is formed by insert molding the terminals in the insulative housing.

Figure 12 is a side sectional view showing the manner in which the housing subassembly in positioned in the shield during fabrication of the connector.

Figure 1 shows the basic elements of a PCMCIA card assembly or frame kit 2 that uses an input/output electrical connector or header 18 complying with the PCMCIA Open System Standard. This PCMCIA card assembly 2 comprises an interface between a computer or other processor and a local area network, modem or similar system communicating with the computer or processor. The heart of the PCMCIA card assembly 2 is a PCMCIA card or memory card 4. This card 4 is a printed circuit board. Circuit elements or components used for storing, receiving, transmitting or other standard data processing or manipulation are mounted on this printed circuit board. For example, PCMCIA card 2 can contain all of the circuit elements necessary to implement a modem, or it can comprise a network interface card. The specific components to be mounted on this card or printed circuit board are not shown, since the specific circuits are not relevant to the input/output connector that is the subject of the invention disclosed herein. The PCMCIA card assembly also includes a top cover 6 and a bottom cover 8. This PCMCIA card assembly 2 is approximately 85 mm. long and 55 mm. wide.

PCMCIA card assembly 2 has two electrical connectors located at opposite ends. A socket or receptacle connector 10 is located at one end. This receptacle connector 10 includes socket terminals of conventional construction which mate with pins protruding into a card slot on a computer when the PCMCIA card assembly 2 is mated with a computer. Insertion of the card into the slot and mating engagement of this connector with the computer is conventional in nature and need not be shown. An input/output electrical connector or header or card I/O connector 18 is located at the opposite end of the card assembly 2. This header 18 is mounted in a peripheral frame forming part of the lower cover 8 and is soldered to the card 4 in a cutout or notch on this end of the card. Surface mount pads 12 are located in this notched region adjacent to the edge of the card 4. Two mounting holes 14 are located on opposite sides of the array of pads 12. This input/output connector or header 18 mates with a cable connector 16. Both the cable connector 16 and the card I/O connector 18 comply with the PCMCIA Open System Standard as more specifically described in Release 2.0, Section 3, I/O Connector Specification.

Figure 2 shows the mating face of the preferred embodiment of the PCMCIA Card I/O connector 18. Figure 3 shows the rear face of the connector 18 and shows three different elements, the housing subassembly including the molded insulative housing 20 and the terminals 60, the clamshell shield 80, and two striker plates 76. Figures 4-8 are detailed two dimensional views of the housing subassembly. This card I/O connector is relatively small. Card I/O connector 18 is approximately 17.40 mm wide, 4.40 mm high and 8.80 mm deep.

The molded insulative housing 20 is a one piece member comprising a base 22 with two mounting arms 30 and a keyed housing spline 38 extending from the housing base 22 toward the front of the card I/O connector 18. The base top surface 24 and base bottom surface 26 are substantially identical and are mutually parallel. The base rear surface 28 is substantially flat and the terminals 60 extend through the base mounting surface. The keyed housing spline 38 is an integrally molded extension from the front of the housing base 22. This keyed housing spline 38 is substantially parallel to the top and bottom base surfaces 24, 26 and is positioned between these two surfaces. The side ends of the keyed housing spline 38 are spaced from the two base mounting arms 30, and gaps are formed between the spline 38 and each mounting arm 30.

Slots 34 extend through the base 22 in alignment

with these gaps between the spline 38 and the mounting arms 30. As seen in Figure 5, the mounting arms 30 are substantially C-shaped in cross section with the slots 34 being positioned in the center of the C-shaped cross section. Crimp grooves 32 extend between the front and rear along the outer surface of each mounting arm 30. The base 22 also includes a rib 36 located on the top and bottom surfaces. The crimp grooves 32 and the housing ribs 36 are used to mount the shield 80 on the molded housing 20 in a manner to be subsequently described in more detail.

The blade-like keyed housing spline 38 extending from the front of the base 22 has a keying face 48 and an oppositely directed contact face 50. The entire contour of the keying face 48 comprises keying means mateable with a compatible female keying surface (not shown) on the cable connector 16. Both of these keying surfaces are defined by the PCMCIA Open Systems Standard so that noncomplementary connectors cannot be mated. For example, a cable connector having a local area network keying configuration cannot be mated with an card I/O connector having a modem keying configuration. The keying means for the card I/O connector 18 comprises a series of key tongues 42 protruding above the centerline of the spline contact surface 50 and key grooves 44 recessed below the contact surface 50. It is the relative position of keys 42 and grooves 44, along with the orientation of the angled or chamfered spline side edges 40 that form the keying configuration or keying means on card I/O connector 18.

Contact terminals 60 extend along contact surface 50 on the keyed spline 38. This contact surface 50 is on the face on the oppcsite side of the keying spline face 48 where the tongues 42 and the grooves 44 are located. This contact surface 50 extends from the front of housing base 22 to the forward spline edge 46. A spline rib 54, molded as part of the housing spline 38 extends between the forward spline edge and the forward end 72 of each terminal 60. These spline ribs 54 protect the terminals during mating so that the mating cable connector does not bend the terminals. The embodiment of the card I/O connector 18 depicted herein also includes a spline ridge 56 which extends from the base 22 to the spline forward edge 46. Inspection of Figure 10 shows that this spline ridge is located between two terminals 60. The spacing between the spline ridge 56 and each adjacent terminal is the same as the spacing between adjacent terminals. The spline ridge 56 is a molded replacement for an omitted terminal. As will be subsequently described, a spline ridge 56 is molded when a terminal is omitted from the card I/O connector 2. Terminals can be omitted when the terminal in that position is not used by the specific PCMCIA card application with which that connector is to be used. A recess 58 is located at the juncture between the base 22 and the spline 38 next to the spline contact surface 50. This recess 58 is also formed during the molding process and will be subsequently discussed in more detail.

The terminals 60 are stamped and formed, and in the preferred embodiment, these terminals are formed from a material such as brass. These terminals are substantially square in cross section and are approximately .25 mm on each side. The card I/O connector 18 conforming to the PCMCIA Open Systems Standard employs up to fifteen terminals 60. The centerline spacing between adjacent terminals 60 is 0.8 mm. A row of terminals 60 includes two types of terminals 62 and 64 that differ only in their relative length. The terminals 62 in positions one and fifteen on the ends of the array of terminals function as make first, break last terminals and are longer than the other signal terminals 64. The length of the make first, break last terminals is 3.9 mm., and the length of the other signal terminals is 3.0 mm. The forward ends 72 of the longer make first, break last terminals are closer to the forward spline edge 46 than the forward ends 72 of the other signal terminals 64, so that this terminals engage mating cable connector terminals first (make first) and disengage after the other terminals during unmating (make last). Generally these make first, break last terminals 62 are ground terminals and their make first, break last configuration prevents undesirable signal levels from being transmitted over the other signal terminals.

Each of the terminals 60, positioned along the contact surface 50 is positioned behind a spline rib 54 as previously described. The bottom 68 of each terminal 60 is slightly below the portion of the contact surface 50 immediately adjacent each terminal and the top surface 66 of each terminal protrudes above the aligned spline ridge 56. Each terminal has a rear section 74 extending from the rear of the housing base 44. This rear section 74 is configured so that the terminal can be surface mount soldered to a corresponding surface mount pad 12 on the PC card 4. Each terminal 60 also extends through the housing base 22 and the housing is insert molded around the terminals 60. This insert molding step will be subsequently discussed in more detail. Each terminal 60 extends from the housing base 22 through the recess 58 at the juncture of the base and spline. This relative position between the terminals 60 and the recess 58 is also a function of the insert molding process to be discussed subsequently.

The two slots 34 extend through the housing base 22 and are aligned with the gap between the mounting arms 30 and the housing spline 38. Each slot 34 receives a striker plate 76 inserted from the rear of the housing. As shown in Figure 3, each striker plate 76 includes a rectangular opening 78 adjacent the front edge of the striker plate. This opening 78 is positioned to engage a latch on the cable connector 16 when the cable connector and the card I/O connector are mated. The position of this latch on the cable connector 16 is specified by PCMCIA Card Standard - Release 2.0.

The striker plates 76 are inserted into slots 34 prior to assembly of the shield 80 on the housing 20. The shield 80 is a clamshell stamped and formed member.

The preferred embodiment of the shield is formed from stainless steel. Shield 80 has a top section 86 and a bottom section 88. Two shield tabs 82 are bent down from the top shield section 86, as best seen in Figure 3. These shield tabs 82 also include distal tab sections 84 that are in turn bent down from the shield tab 82. These distal tab sections are dimensioned to fit in the two holes 14 on the PC Card 4 that are shown in Figure 1. These shield tabs can be soldered to the PC Card 4 and serve to mechanically secure the card I/O connector 18 to the PC Card 4.

The shield 80 also includes a frame section 92 located between the top shield section 86 and the bottom shield section 88. The top shield section 86 is joined to the upper frame section 96 and the bottom shield section 88 is joined to the lower frame section 98. This frame section is best shown in Figure 2. The frame section 92 also includes side frame sections 100 which join the upper frame section 96 to the lower frame section 98 at both ends. A central opening 94 is formed by the upper, lower and side frame sections, all of which are in a common vertical plane perpendicular to the housing spline 38, to the terminals 60 and to the direction in which the cable connector 16 is inserted into mating engagement with the card I/O connector 18. As shown in Figure 2, this central opening 94 is generally rectangular with two chamfered sections located at the top corners where the upper frame section 96 joins the two side frame sections 100. The contour formed by this central opening 94 forms the peripheral mating surface for engagement with the cable connector 16. This contour is for a Type II configuration defined by PCMCIA Open Systems Standard, Release 2.0. This standard does not, however, require that this peripheral mating contour be formed by the shield or by portions of a shield in a common plane.

Shield 80 also includes contact tabs for establishing ground contacts with both the card assembly and with the cable connector 18. Spring tabs 104 are struck from the top and bottom shield sections. These tabs 104 engage the top cover 6 and the bottom cover 8 when the card I/O connector 18 is attached as part of the card assembly 2. A cantilever spring section 90 extends from the inner edge of the upper frame section 96 toward the rear of the connector. This cantilever spring section 90 is shown in Figure 12 where the shield 80 is shown in its partially open position prior to assembly to the housing 20. This cantilever spring section 90 is positioned to engage a shield on the cable connector 18 when mated with the card I/O connector 18. The cantilever spring section 90 extends between the top shield section 86 and the bottom shield section 88. Cantilever spring section 90 also extends between the top shield section 86 and the keying surface on the housing spline 38 when the shield is mounted on the molded housing 20.

The shield 80 surrounds the molded housing 20 and the mounting arms 30 support the shield 80. Side sections 102 extend inwardly from the top shield section 86 and the bottom shield section 88 and secure the shield 80 to the mounting arms. The ends of the side shield sections 102 are crimped inwardly into the crimp grooves 32 on the outside of the mounting arms 30 to secure the shield 80 to the housing 20. Slots 106 located on the top and bottom sections of the shield 80 are dimensioned to receive ribs 36 molded on the top and bottom faces of the housing base 22 to provide additional retention of the shield 80 on the housing 20. Side shield tabs 108 extend downwardly from both sides the top shield section 86. These side shield tabs 108 are dimensioned so that they engage the PC card to support the card I/O connector 18. These side shield tabs 108 can be soldered to pads on the printed circuit board to provide additional mechanical security. Lateral shield tabs 110 also extend from the sides of the shield 80. These lateral shield tabs 110 are located adjacent to the front of the shield 80 and extend from the side frame sections 100. The lateral shield tabs 110 initially are bent rearward relative to the frame section 92 and then extend laterally out from each side of the shield 80. These laterally extending tabs 110 are inserted in slots on the PC card assembly frame on each side of the cutout section in which the card I/O connector 18 is mounted so that the connector 18 and the PC card to which it is attached are properly positioned relative to the card frame and to the bottom cover 8.

As best shown in Figure 2, each part of the shield frame section 92 is joined to a portion of the shield extending rearward and perpendicular to the plane of the shield section. This frame section 92, which forms the peripheral mating surface of the opening 94 through which cable connector 16 is inserted during mating, is therefore relatively robust and rigid and will not significantly deform during connector mating. In particular, the top shield section 86 will not tend to bow outward during insertion of a cable connector 16 through opening 94. Since the keying surface on spline 38 faces this top section 86, any tendency of the top section to bow outwardly during mating could permit insertion of a cable connector with the wrong keying configuration.

Figures 11 and 12 show two of the steps in the fabrication the I/O card connector 18. The insulative housing 20 is insert molded around the terminals 60. Figure 12 shows the extraction from the mold of the insert molded subassembly including the terminals embedded in the housing. The mold used in this insert molding process includes three pieces. The top mold piece includes a cavity, not shown, which molds the top surface of the housing 20. This top mold piece engages the mold base 118 which contains a mold cavity the molds the lower housing surface. The arrow on the top mold piece, 116 shows that the top mold piece has raised after the housing has been molded. The lower arrow shows that the housing subassembly has been ejected from the cavity in the mold base 118. The mold used to insert mold the housing around the terminals 60 also includes a third section in form of a mold slide 114. The arrow in Figure

11 shows that this mold slide 114 moves in a direction parallel to the interface between the top mold piece 116 and the mold base 118. The first step in fabricating the housing subassembly is to position terminals 60 on a carrier strip as shown in Figure 11 in the mold cavity between the top mold piece 116 and the mold base 118. The terminals 60 are joined to the carrier strip at the rear, and the forward ends of the terminals 60 are separate. The terminals extend into the mold cavity toward the mold slide 114. After the terminals are positioned in the cavity in the bottom mold base 118, the mold slide 114 moves into position. Then the top mold piece 116 is moved into the closed position. The mold slide 114 has an internal cavity which includes a mold surface 112 which forms the contact surface of the housing spline 38. The mold surface 112 also include a series of grooves in which the individual terminals are positioned during the insert molding process. The front portion of the mold surface 112 extends slightly forward of the remainder of the mold front face and each groove in this mold surface includes a lead-in that aligns the individual terminals and insures that the terminals are properly positioned in the grooves. This portion of the mold is too small to be seen in Figure 11. Since this portion of the mold surface 112 extends beyond the surrounding area on the front of the mold slide, the recess 58 at the juncture of the housing base and the spline 38 is formed. The opposite side of the mold surface 112 forms the tongue and groove configuration of the keying surface on spline 38. Since the tongues 42 and grooves 44 are parallel to the terminals 60, the mold slide 114 can be withdrawn parallel to the tongues 42 and grooves 44 and to the terminals 60 after plastic has been injected around the terminals.

Molding the housing spline 38 in this manner has several advantages. Since a number of keying configurations may be required on the spline, only the mold slide needs to be changed to mold a different connector housing. Since each configuration of the molded spline is molded with only this simple mold change, there is no need to use the prior art expedient of inserting additional keys in a common spline configuration to form different keying configurations. These additional keys can fall out during use and require an additional assembly operation that adds to the manufacturing cost. The grooves on the mold surface 112 of the mold slide also position the terminals in the mold without the need for additional pins to hold the terminals in position. The spline ribs 54 protecting the front of the terminals 60 are also easily molded using this approach because they are aligned with the terminals. Insert molding also provides a tight fitting interface between the terminals 60 and the housing base 22. Insert molding also facilitates the fabrication of connectors including only a portion of the terminals. If one or more terminals is unnecessary for a given application, it can be omitted. The omitted terminals are simply punched out of the terminal lead frame before positioning the lead frame in the mold. Plastic injected into the mold will then fill up that portion of the mold cavity otherwise occupied by the omitted terminal. There will be no opening in the base 22 caused by the omission of one or more terminals. The groove on the mold surface 112 will also be filled by the injected plastic resulting in the formation of the spline ridges 56 shown in Figures 9 and 10.

After the housing assembly has been molded by this insert molding step, the stiker plates 76 are first inserted in the housing and then the shield 80 is positioned around the housing. Figures 2, 3 and 12 show the simple attachment of the clam shell shield 80 to the housing 20.

These assembly and fabrication steps are especially adapted to the automated assembly of card I/O connector 18. There is no need to individually insert or otherwise handle the terminals and the terminal insertion step required by other assembly operations is eliminated. Small core pins which can be damaged and not needed to mold cavities in the housing or to position the terminals for insert molding. The shield is used to secure the entire connector to the PC card eliminating the expensive step of assembling rivets to the connector. The shield is also formed in a relatively rigid configuration for more reliable keyed connector mating. Although the preferred embodiment of this connector disclosed herein is compatible with the PCMCIA Open System standard it should be understood that the advantages of this insert molded product and this shield configurations are also applicable to Closed System or proprietary PCMICA connector configuration and to other small high density electrical connectors. Therefore the embodiment depicted herein is representative and is not the sole example of an electrical connector in accordance with the invention as disclosed and claimed herein.

Claims

1. An input output electrical connector for use in a PCMCIA card assembly, the connector comprising:

a molded insulative housing (20) including a base (22) with a keyed housing spline (38) extending forward from the base, the spline having keying means (42, 44) on one face and a contact surface (50) on the opposite face;

a plurality of terminals (60) extending side by side through the base and along the housing contact surface with the top of each terminal being exposed along the contact surface, each terminal also extending from the rear (28) of the base for attachment to a card in the PCMCIA card assembly;

the connector being characterized in that the terminals (60) are insert molded in the insulative housing (20) with the base (22) being molded around a portion of the terminals extending therethrough and with the contact surface (50)

on the housing spline (38) being formed by a mold surface (112) initially positioning the terminals and withdrawn parallel to the terminals.

2. The electrical connector of claim 1 wherein at least a portion of the terminals (60) have a forward end (72) inwardly spaced from a forward edge (46) of the housing spline, and the contact surface (50) includes housing spline ribs (54) molded between the forward ends (72) of the terminals and the forward edge (46) of the housing spline.

3. The electrical connector of claim 2 wherein each spline rib (54) is formed by the mold surface (112) positioning the terminals along the housing spline.

4. The electrical connector of claim 1 wherein at least one of the terminals (60) is a make first, break last terminal (62) with a forward end (72) extending beyond the forward end of the other terminals (64).

5. The electrical connector of claim 1 wherein a recess (58) is located at the juncture of the base (22) and the contact surface (50), the recess being formed by withdrawal of the molding surface parallel to the terminals.

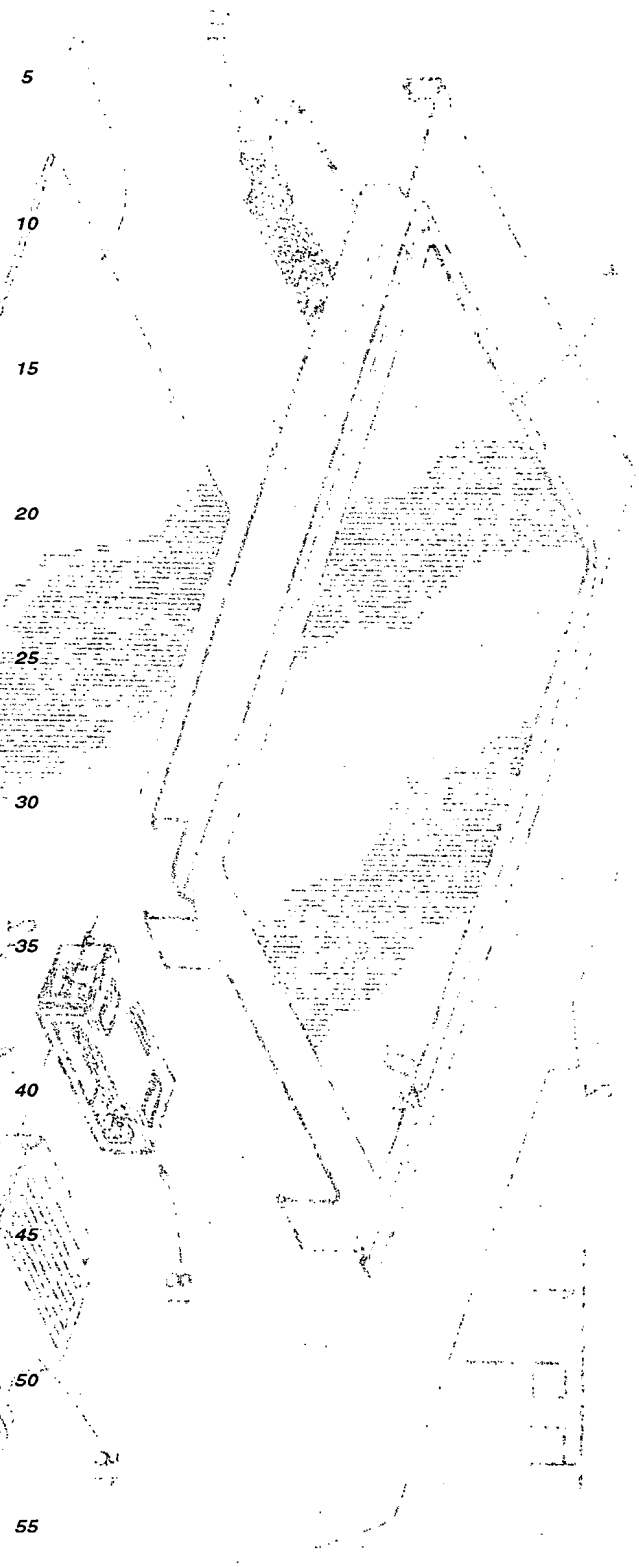
6. The electrical connector of claim 5 wherein the recess (58) extends into the housing base (22) parallel to the contact surface (50), the housing base extending over the top of the recess.

7. The electrical connector of claim 1 wherein at least one molded ridge (56) extends between two terminals (60) on the contact surface, the molded ridge extending from the base (22) to a molded rib (54) located on the forward edge of the housing spline.

8. The electrical connector of claim 1 wherein a shield (80) is wrapped around at least a portion of the housing and the terminals, the shield having at least one tab means (82) for securing the shield to the card and for securing the electrical connector to the card.

9. The electrical connector of claim 8 wherein the insulative housing includes mounting arms (30) extending from two ends of the base (22), the shield being supported by the base and the two mounting arms.

10. The electrical connector of claim 9 wherein the housing base (22) includes protruding ribs (36) on opposite sides of the base, the shield including slots (106), the ribs extending into the slots when the shield is mounted on the housing.



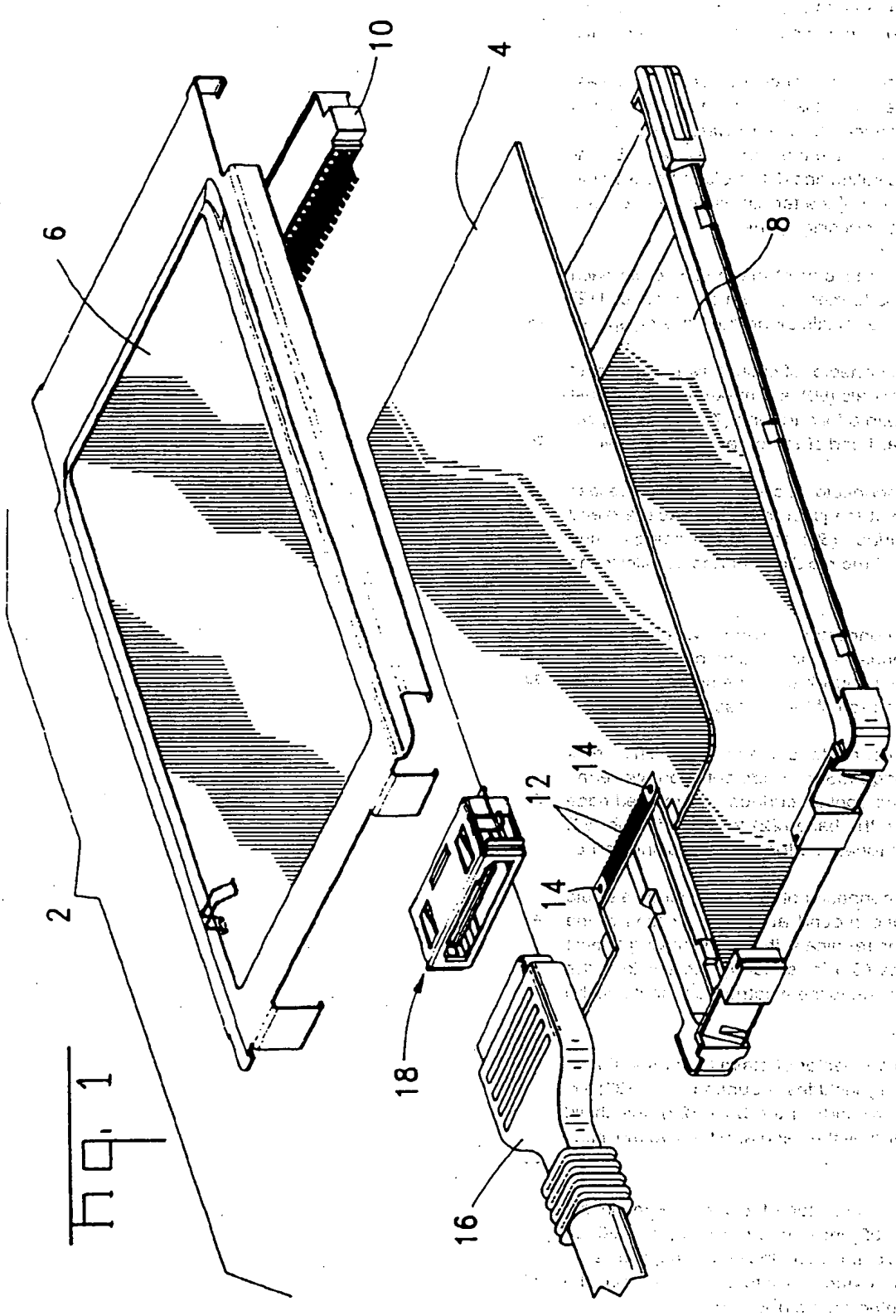


Fig. 1

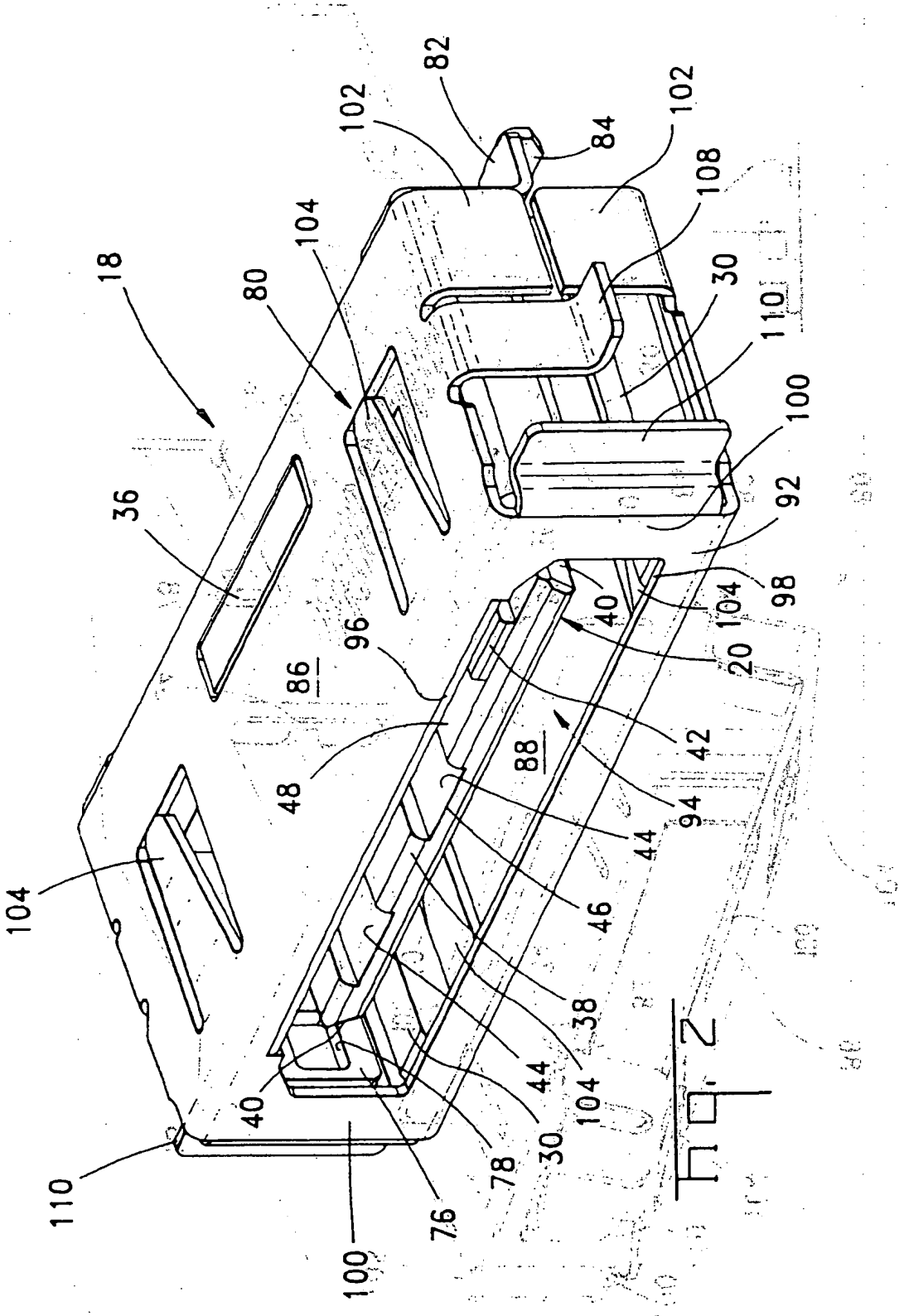

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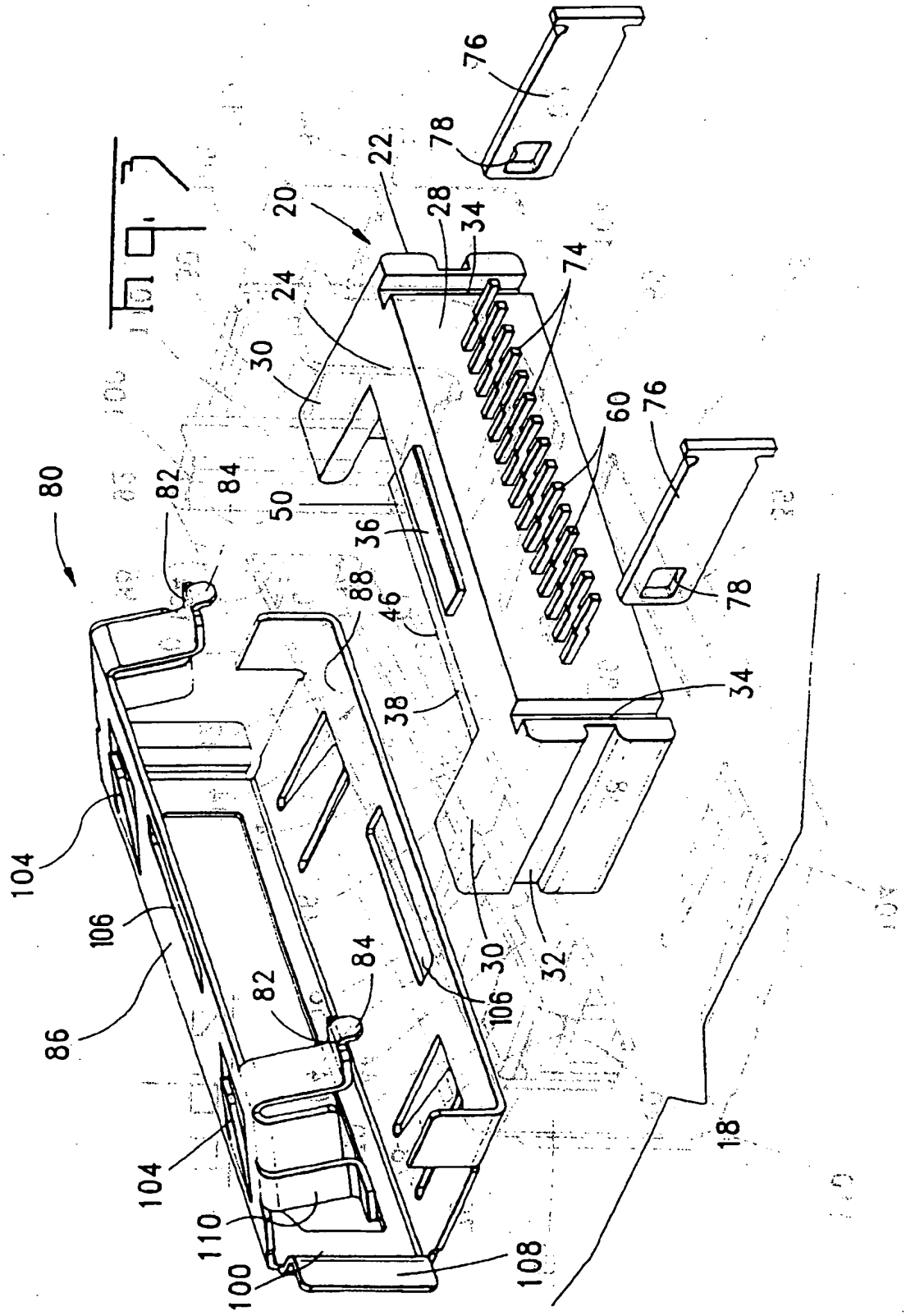
FIG. 2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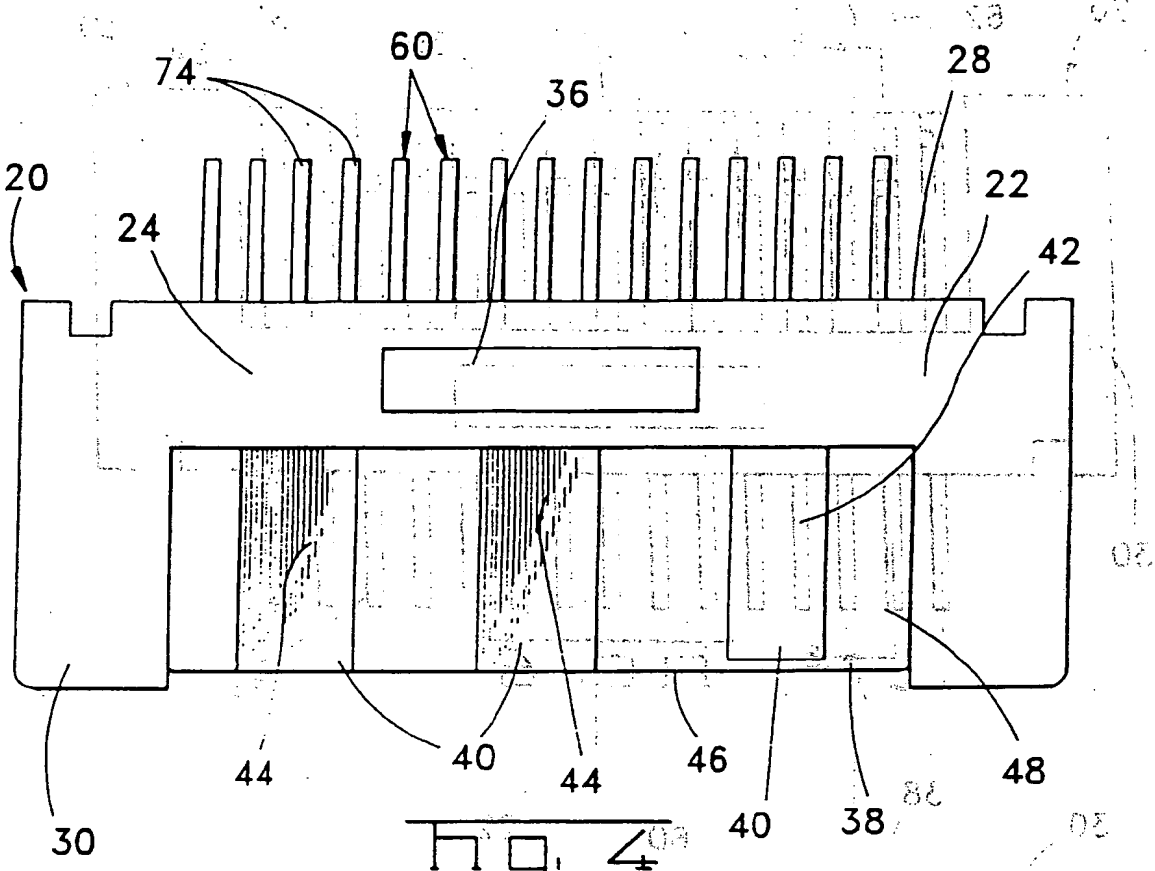
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Fig. 4

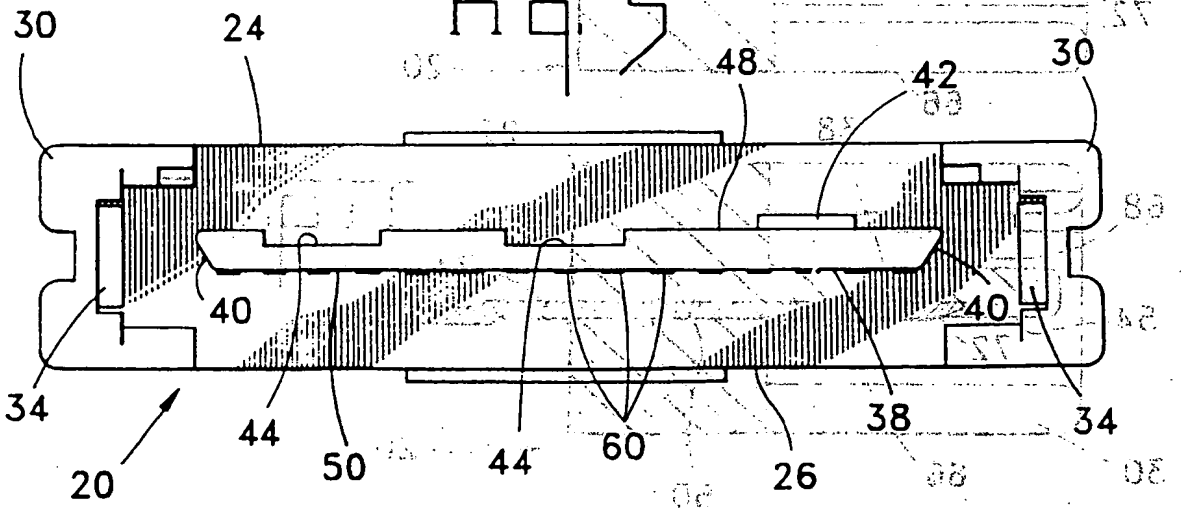
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Fig. 5

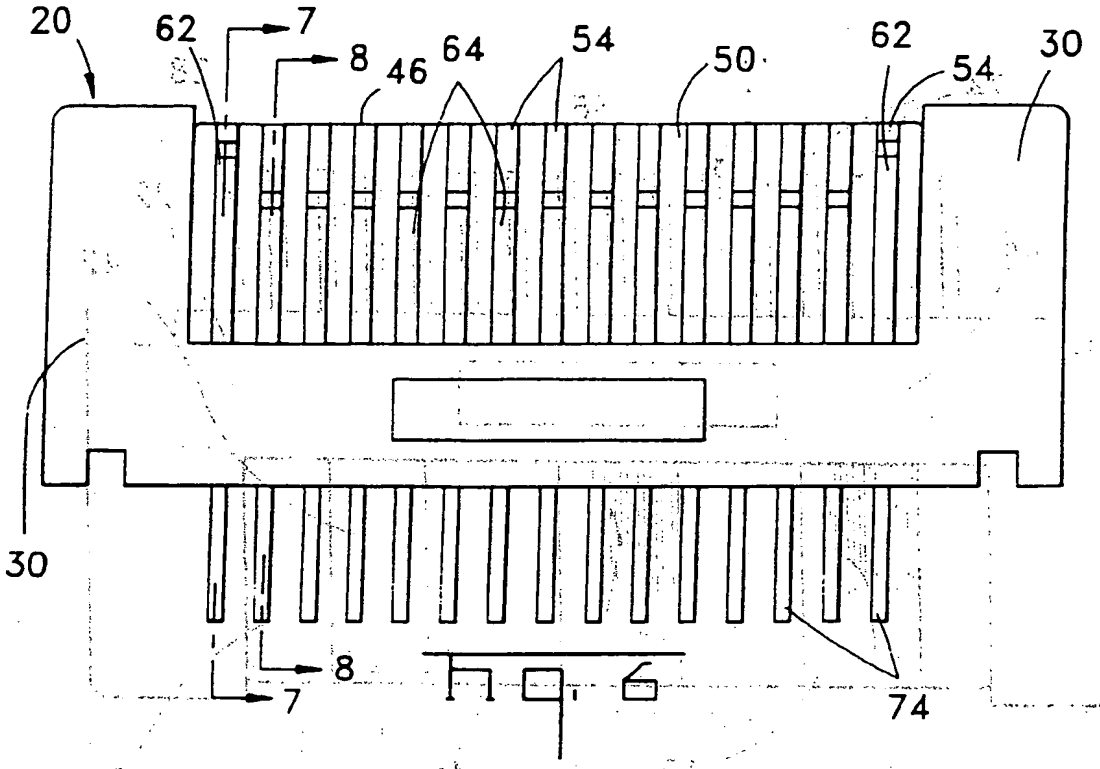
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Fig. 6

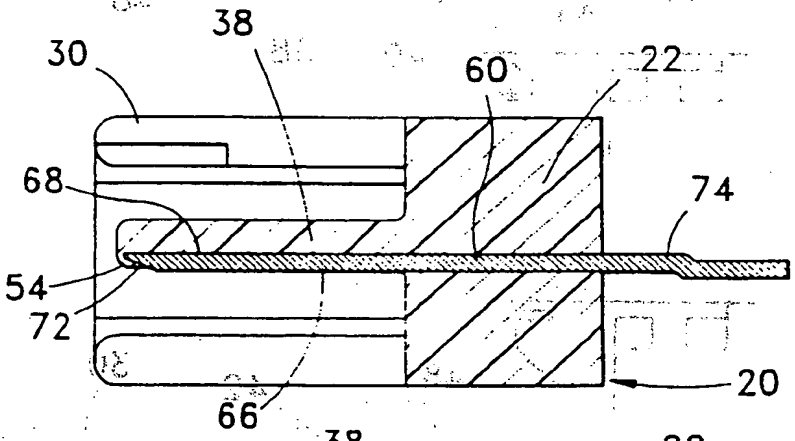
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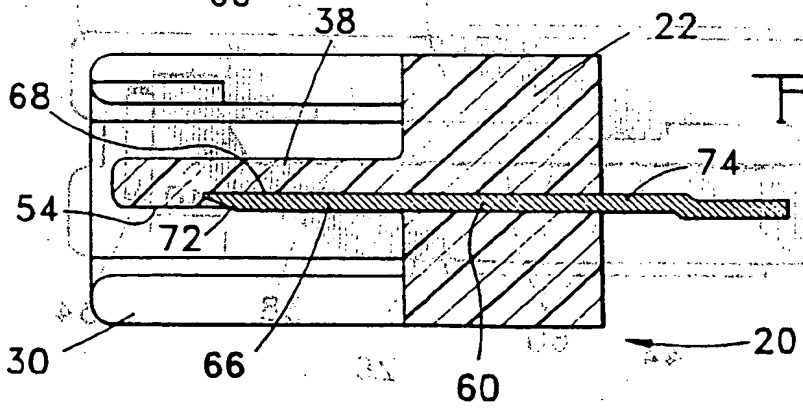
Fig. 7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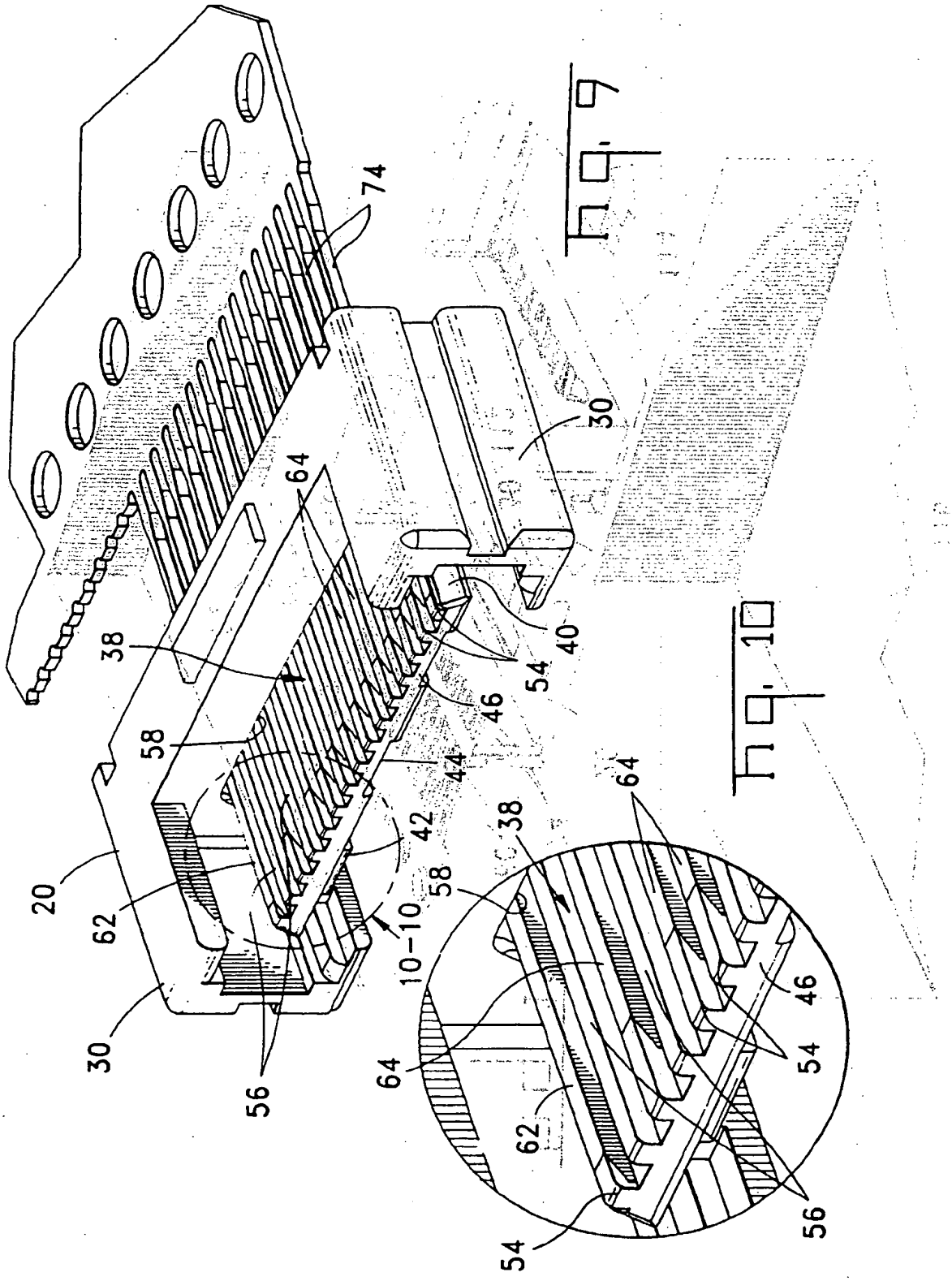

Fig. 9

Fig. 10

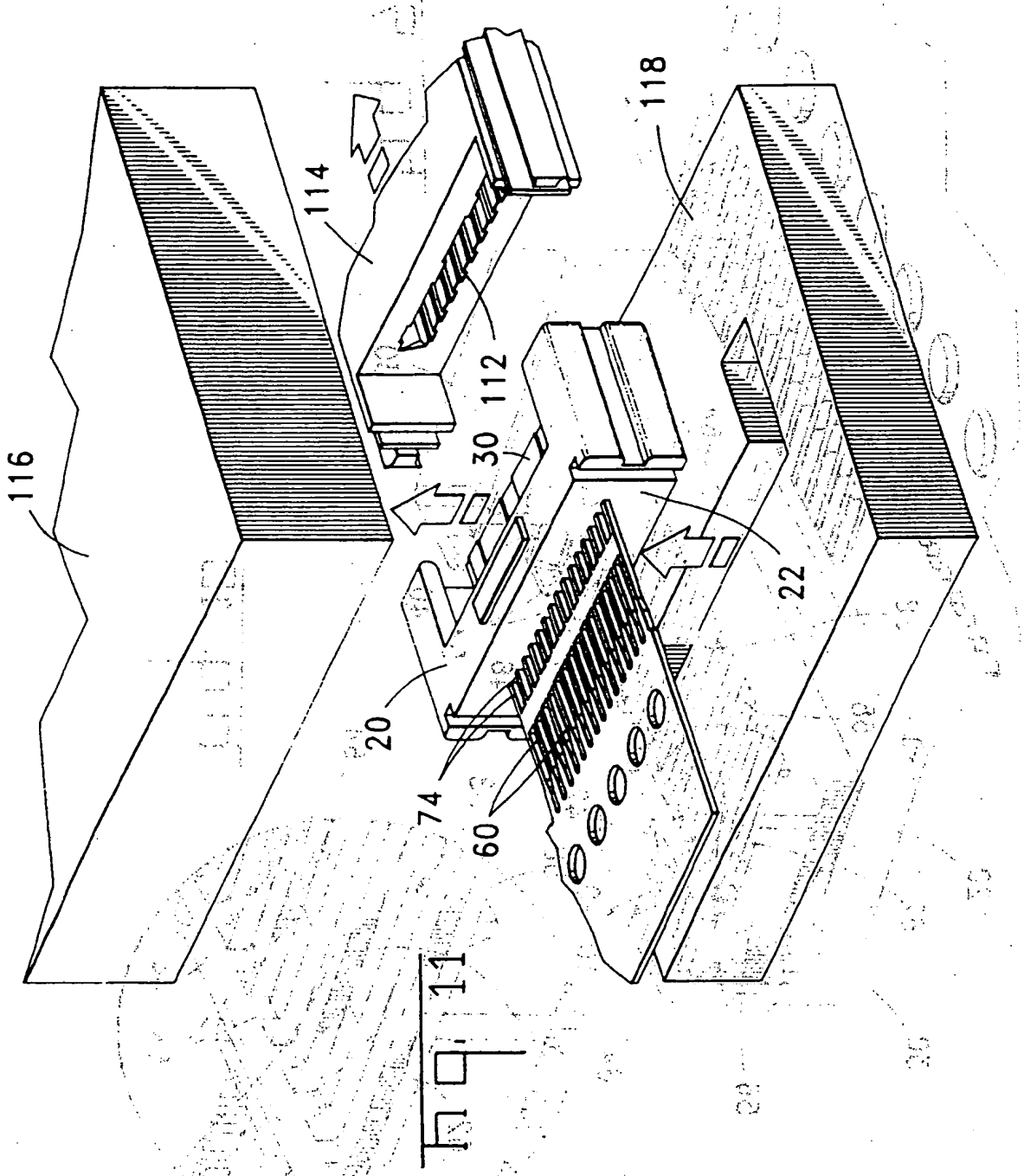

Fig. 11

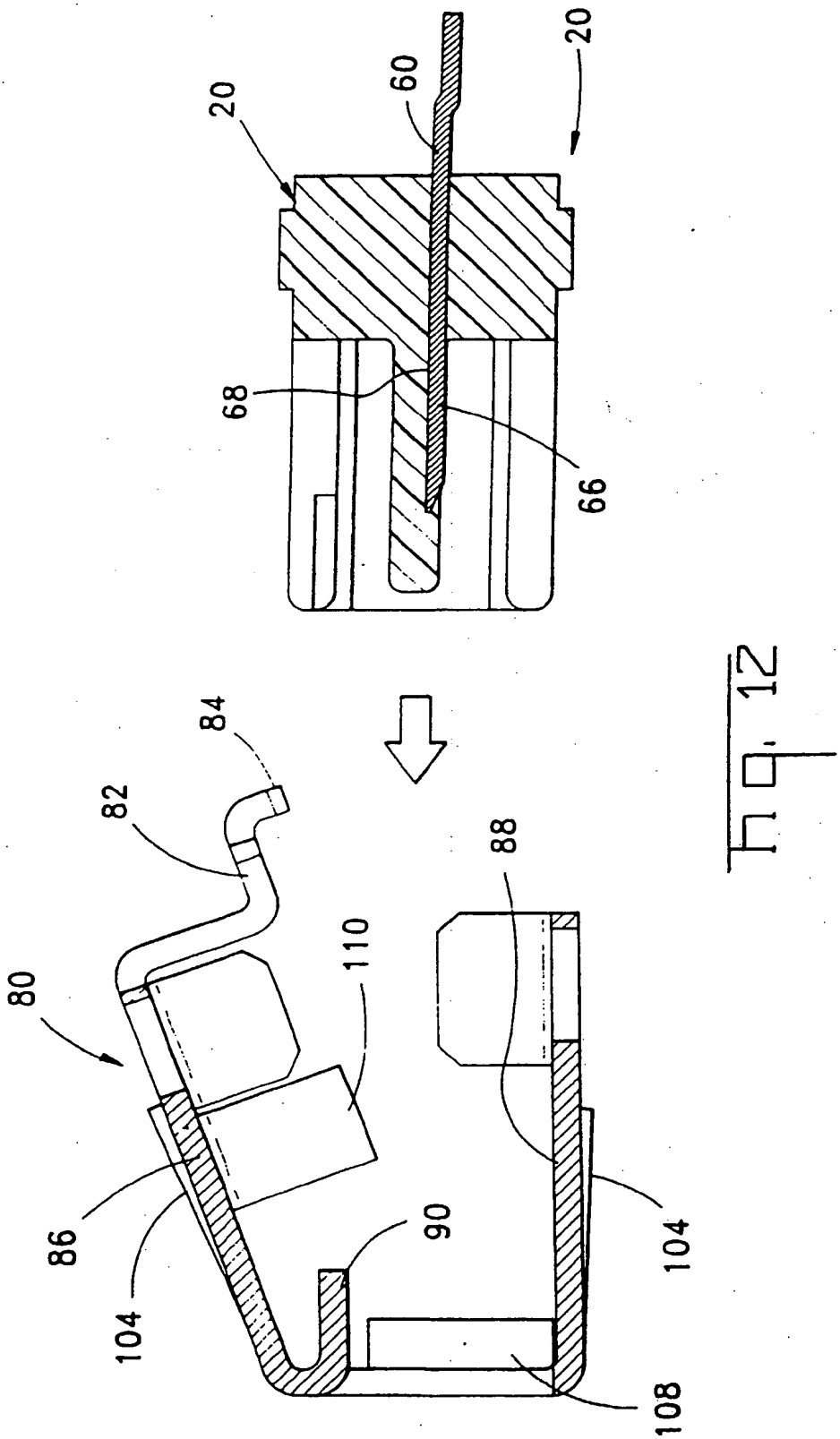

Fig. 12

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European Patent Office
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28.08.1996 Bulletin 1996/35

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(54) PCMCIA input/output card connector

(57) An input/output electrical connector (18) is compatible with the PCMCIA Open System Standard. A PCMCIA card assembly uses the connector. This connector (18) is a card I/O connector or header that is mounted on the edge of a PC card. The connector includes a plurality of terminals (60) insert molded in a housing (20). The housing includes a keyed spline (38) and an oppositely facing contact surface (50) with the tops of a row of terminals (60) exposed. The spline is molded by a mold slide that is retracted parallel to the tongue and groove keys and to the terminals (60). Molded ribs (54) are formed in front of the terminals to prevent stubbing during mating. A clam shell shield (80) surrounds the housing and a frame section (100) on the front of the shield defines the peripheral mating interface on the card I/O connector. The shield also includes mounting tabs (82) for securing the shield (80) and the connector (18) to a PC card without the use of separate rivets or fasteners.

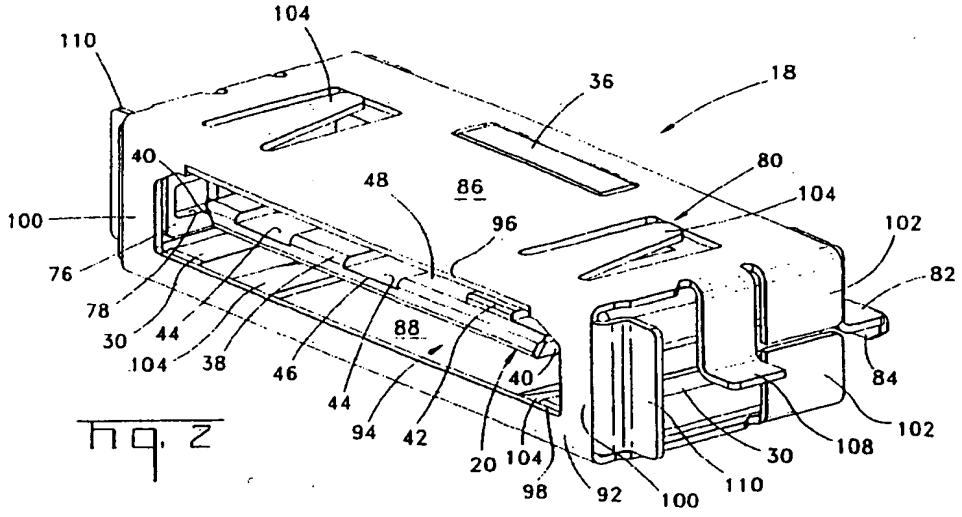

Fig. 2

EP 0 729 206 A3

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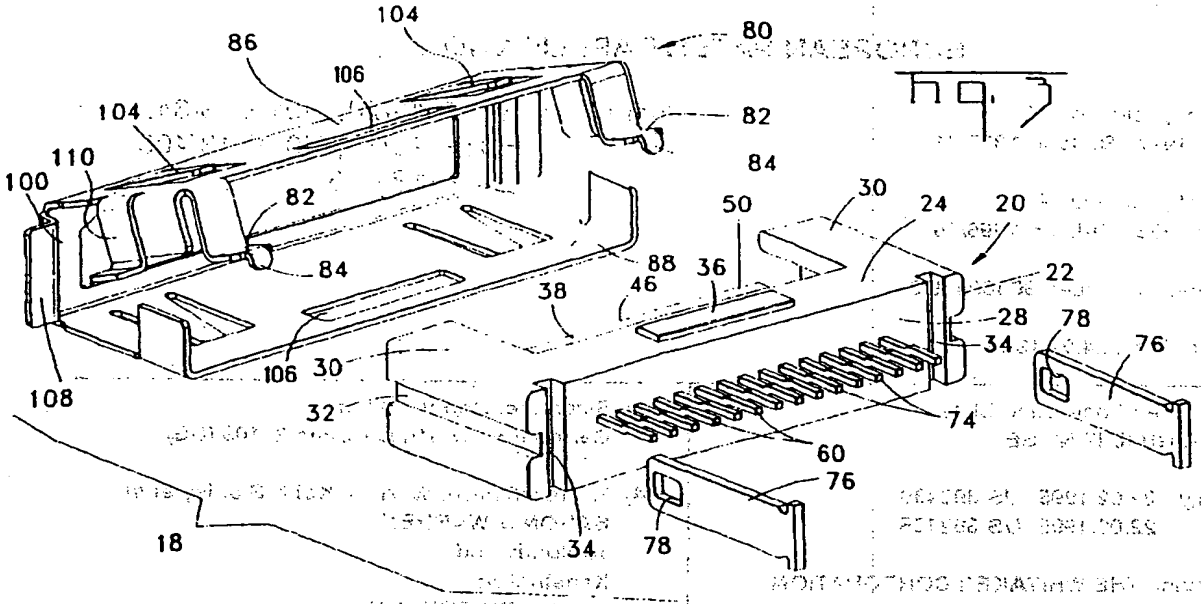
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EUROPEAN SEARCH REPORT

Application Number
EP 96 30 0459

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	GB 2 233 596 A (DESBURY LTD) 16 January 1991 * the whole document * ---	1	H01R43/24 H01R13/64 H01R23/70 H01R13/405
A	US 5 201 883 A (ATOH KIYOSHI ET AL) 13 April 1993 * column 3, line 6 - column 5, line 31 * ---	1	H01R13/658
A,D	US 5 330 360 A (MARSH EDWARD K ET AL) 19 July 1994 -----		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

H01R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	13 August 1997	Salojärvi, K

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